User Inputs

Cable

In their supplementary filing, the sponsors of the Hatfield Model note that conduit installation costs for copper feeder cable and fiber feeder cable are the same for all population densities except in areas with a population density greater than 2,550. In that instance, conduit installation costs decrease by $5 per foot. There is no reason for this change.

The costs of installing buried cable are understated substantially, especially for the density zone of from 1 to 5 households. The already unrealistically low cost per foot for trenching becomes ludicrous when that cost is divided according to the structure sharing proposed in the model.

The cable costs that the Hatfield Model specifies apply to the least cost cables. The loops that the model designs will require heavier gauge cables. In their supplementary filing, the sponsors of the Hatfield Model note that the model assumes that cables with 2,400 or fewer pairs contain 24 gauge copper wires. They also note that the model assumes that cables with more than 2,400 pairs contain 26 gauge copper because "24 gauge copper cables are not manufactured in sizes larger than 2,400 pairs." This will skew cable costs and affect transmission characteristics significantly.

The Hatfield Model tables display variable costs for fiber cable inclusive of engineering, delivery, and installation, as well as the actual cost of the cable. The table for Fiber Feeder Buried installation costs includes an additional cost per foot for burial. This will increase the cost for fiber feeder, as there is no mechanism to reduce the proportionate amount of cable costs for installation, which already is built into the fiber feeder costs.

Conduit

The Hatfield Model assumes a very low constant price per foot for conduit. This single

cost makes no provision for bends, sweeps, ells, unions, caps, solvents, or PVC cement. The model appears to make no provision for unusual situations in conduit systems, such as areas requiring galvanized iron pipe ("GIP") or black iron pipe ("BIP") laterals, risers, or river crossings.

There are inconsistent references in the Hatfield Model, as shown in the cost tables for conduit that suggest a four way system with pricing of $4 per conduit, or an average of $1 per foot. The sponsors should clarify this point in the model.

Construction Costs

Construction costs per square foot for 50,000 line switches should not be twice the construction costs per square foot for 999 line switches. The costs shown for smaller line facilities appear to refer to the costs of room build-outs or allocation costs rather than new building costs. New building costs would maintain a more consistent cost per square foot on average.

Discounts

The Hatfield Model does not accept user defined discount factors. This will be a disadvantage when using the model for smaller companies and in non-Bell serving areas. This is because smaller ILECs and ELECs will be operating with smaller subscriber bases and therefore will enjoy smaller discount levels than those afforded to Bell Operating Companies in large urban areas. The Hatfield Model ignores the higher costs that ILECs will face as a result of losing discounts associated with economies of scale and scope (versus current pricing). Moreover, the Hatfield Model ignores the higher costs that ELECs will face as a result of losing discounts associated with economies of scale and scope (versus current pricing).

Labor Rates

There is no documentation of the labor rates. The cable costs appear to include labor dollars, but we cannot confirm this with certainty. Without isolating the labor costs, it is impossible to confirm their accuracy. Moreover, it will be impossible to confirm their applicability by region to incorporate variations in labor rates.

An EF&I labor rate of $55 per hour is too low by half if company personnel are doing the work. The loaded labor rate for company personnel would be closer to $130 per hour. In conjunction with this item, the new model uses unit rate costs for patch panels and for pigtails and then inserts this line item for EF&I for exactly the same associated costs. Does the model input both or is the EF&I shown for reference only?

Land

The model implies that the per foot cost of land increases with the amount of land purchased. The land area for COs is usually the same. Arguably, the larger the CO, the closer the walls are to the fence (because of standardization in parcel sizes and purchasing practices). This is evidence of the interoffice or inter-exchange carrier bias of the model. The designers of the model should give greater consideration to actual land costs to establish a more meaningful set of default values.

Line Cards

The Hatfield Model contains an incorrect downward adjustment of the line card prices. The model uses modified versions of values published in the *U.S. Central Office Equipment Market: 1995 Edition*. Northern Business Information, the division of McGraw-Hill responsible for producing this publication, has provided independent confirmation of the impropriety of these modifications.[17]

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[17] Correspondence from Mr. William L. Hahn, Inquiry Analyst, Northern Business Information to Ms.

Manholes

Assuming the purchase of fiber cable in minimum 2 kilometer lengths, and assuming the manhole spacing of 1,000 feet shown in the model, it appears that the model makes no provision for splicing and racking. Manhole spacings of 900 feet (center to center) would yield better results for this reason.

Pay Stations

We have no comment on the price of $1,200 used in the model. However, this is not a supported service and we question why the model includes this information.

Regenerator

The cost of $15,000 is unreasonably low. Given that MCI's historical price was $150,000 for a typical area, we suggest that a typographical error may be present.

Resurfacing

The Hatfield Model specifies a cost for resurfacing of $10 per square foot of unspecified lift This cost appears to be too high by a factor of at least 3, depending on the lift or thickness of the resurfacing.

Scale

The Hatfield Model restricts input data to CBGs served by Bell Operating Companies.

Robin Sanders, Bell Atlantic (undated, facsimile transmitted September 13, 1996). Mr. Hahn's comments were explicated in a memorandum from K. J. Kelly (Senior Analyst, Northern Business Information) and Lance Lindstrom (Managing Director, Northern Business Information) that was transmitted as an attachment to this letter on September 13, 1996.

Christensen Associates' analysis demonstrates that the model is thus "eliminating many of the highest-cost Census Block Groups (CBGs) from its calculations. Using the Bell-only costs to portray costs for the rest of the state results in a significant understatement of non-Bell costs."

Splicing

The Hatfield Model specified 20,000 feet spacing between fiber splices, which is quite unrealistic. To minimize splice costs, the best possible splice intervals would be approximately 15.9 kilometers (approximately 9,700 feet). This is because, given current normal technology, the maximum length of (for example) 24 fiber cable that will fit on a standard reel is 16 kilometers. Typically, design engineers would allocate 50 meters to each manhole for splicing and racking, hence only 15.9 kilometers would be available for placement.

The Hatfield Model indicates fiber splicing costs of $15: 24 fibers @ $1.60 each. This seems extremely low, particularly under current market conditions.

Conclusion

We have identified and discussed significant shortcomings in the model. Cumulatively, these shortcomings constitute strong evidence of an unacceptable bias in design that would preclude use of the model in any real world design or cost analysis. These shortcomings also indicate a weak design embedded within the software, a weakness than probably could not be overcome by simply recompiling the code or transferring the underlying design to another software application package.

Perhaps the greatest shortcoming is the model's failure to incorporate contemporary thinking about feeder design in a "green fields" situation. The model does recognize that the known wire center locations could be the basis of a SONET system. In Russia, Kuwait, Malaysia, and numerous other countries in which deregulation has occurred, the ELECs are building their competitive networks using Synchronous Digital Hierarchy ("SDH") technology that is essentially identical (for the purposes of this discussion) to SONET.

We consider this to be a significant omission because it indicates a lack of forward looking thinking in design. The failure of the model's designers to consider the use of SONET design principles for construction of the feeder portion of the network is perplexing and inappropriate. We believe this feature should be an integral part of design for any forward looking network because of its low cost, resiliency, and provision of quality supported services, as well as its capacity for enhanced services.

Appendix A. Excerpt from the Joint Board Recommendations to the FCC (Paragraph 277)[18]

"The Joint Board recommends that the Commission use the following criteria to evaluate the reasonableness of any proxy model.

(1) Technology assumed in the model should be the least-cost, most efficient and reasonable technology for providing the supported services that is currently available for purchase, with the understanding that the models will use the incumbent LEC's wire centers of the loop network for the reasonably foreseeable future.

(2) Any network function or element, such as loop, switching, transport, or signaling, necessary to produce the supported services must have an associated cost.

(3) Only forward-looking costs should be included.

(4) A forward-looking cost of capital and the recovery of capital through economic depreciation expenses must be included.

(5) The model should estimate the cost of providing services for all businesses and households within a geographic region. This includes the provision of multi-line business services to allow the models to reflect the economies of scale associated with the provision of these services.

(6) A reasonable allocation of joint and common costs should be assigned to the costs of supported services. This allocation will ensure the forward-looking costs of providing the supported services do not include an unreasonable share of the joint and common costs incurred in the provision of both supported and unsupported services, e.g., multi-line business and toll services.

(7) The models and all underlying data should be available to all interested parties for review and comment. The data should be verifiable, engineering assumptions reasonable, and outputs plausible

(8) The model should be able to examine and modify the critical assumptions and engineering principles. It should also allow for different costs of capital, depreciation and expenses for different facilities, functions, of elements."

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[18] Federal-State Joint Board on Universal Service, CC Docket 96-45, *Recommended Decision*, November 8, 1996, ("Joint Board Decision"), page 9, paragraph 277.

Appendix B. Credentials of Principal Investigator

ROBERT F. AUSTIN, PH.D.

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Clearwater, FL 34630-2810 USA
E-mail: docbo@aol.com

Voice: +1-813-595-7204
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Cellular: +1-813-403-0530

Professional Experience

Austin Communications Education Services, Incorporated

1340 Gulf Boulevard, #18-C, Clearwater, FL 34630-2810 USA

July, 1991 - Present: President. Responsible for GIS training, consulting, system design and corporate management. Clients include Andersen Consulting Kuala Lumpur, Antigua Telephones (APUA), Andrew Corporation, Barbados Telephone, C3, Cadtel Systems, CSC, Edmonton Telephones, Generation 5 Technology, GeoVision, Kancom, Lambda Tech International, Macomnet, Mercator Corporation, Metrocom, Pacific Bell, Rascom, Ramsatcom, SaskTel, Price Technical Services, Sibtelecom, Telebras CPqD, TIME Telekom (TIME Quantum Technology), and the United State Telephone Association (USTA).

March, 1988 - July, 1991: Executive Vice President. Responsible for corporate management and operations; AM/FM/GIS system design and consulting; training classes/seminars in AM/FM/GIS. Clients include AT&T, MCI, and Sprint; Bell, United, General, Alltel, Centel, LCTX, and other operating companies; hardware/software manufacturers; and service bureaus.

Mercator Corporation

652 Avenida Munoz Rivera, El Monte Mall, Tercer Piso, Suite 1, Hato Rey, PR 00918-4149, USA

August, 1996 - Present. President. Responsible for corporate management, training, marketing and consulting. Clients include Government of Puerto Rico (Centro de Recaudación de Ingresos Municipales) and Government of Paraguay (World Bank).

Andrew Corporation

10500 West 153rd Street, Orland Park, IL 60462-3071, USA

Andrew Telecom Networks, 2425 North Central Expressway, Richardson, TX 75080, USA

June, 1994 - September, 1994: Director. Responsible for new business development, strategic planning, and technical training in a start-up engineering services division.

Andrew International, Academy of Sciences, 32A Leninski Prospekt, Moscow, 117334, Russian Federation

January, 1993 - May, 1994: Director, Applications Engineering. Responsible for information systems design and development for several Russian-American joint ventures. Systems designed and/or specified for purchase included office automation, international electronic mail, automated mapping/facilities management, and multi-currency accounting. Also responsible for network product sales, new project bid preparation, and on-going information systems support.

Baystar Service Corporation/CDI Corporation

311 Park Place Boulevard, Suite 650, Clearwater, FL 34619, USA [CDI Corporation acquired Baystar Service Corporation in June, 1989.]

July, 1989 - July, 1991: Vice President, Automated Mapping and Facilities Management Systems. Responsible for all aspects of corporate AM/FM/GIS activity. Clients included Advanced Computer Graphics, Ameritech Services, C3, CFW Telephone, Coastal Utilities, GeoTechnology International, GTE Data Services, GTE Florida, GTE Network Operations Planning, Lufkin-Conroe Telephone Exchange, MCI, MSE Corporation, New England Telephone, New Zealand Telecom, and Southwestern Bell Telephone.

September, 1987 - June, 1989: Director, Automated Mapping and Facilities Management Systems. Responsible for digital cartography marketing, system design, consultation, and project management. Clients included AT&T-EDDS, GTE-Florida, and MCI.

June, 1986 - September, 1987: Regional Manager, Dallas/MCI. Responsible for hiring, salary assessment, and supervision of approximately 70 contract staff; AM/FM consulting, marketing and system definition; microcomputer programming for MCI Telecommunications.

September, 1985 - June, 1986: Computer Data Systems Consultant. As a consultant to MCI, responsible for defining, designing, and implementing a hardware, software, and data conversion system for automated mapping and facilities management; preparing standards and technical manuals for fiber optic outside plant engineering and construction.

Chicago Aerial Survey, Incorporated

2140 Wolf Rd., Des Plaines, IL 60018-1932 USA

June, 1984 - August, 1985: Senior Staff Scientist. Project Manager for digital map conversion project for Southern Bell Telephone Company (PLRMS); managed several raster system projects including J.D. Irving and California Department of Conservation; prepared production reports, technical reports, proposals, and in-house training materials for digital cartography.

Geolocator, Incorporated

412 1/2 W. Walnut, Columbia, MO 65201 USA

February, 1978 - May, 1984: President. Industrial site analysis for state and local gov-

ernments and private sector firms; developed site analysis and mapping applications on mainframes and microcomputers.

Other Communications Industry-Related Experience

Summers, 1969 - 1974: Telephone and CATV craft work, contracted by Harris-McBurney, Rollins Commserve, Ann Arbor Cable, and Saginaw Cable. Work included aerial cable placement (Journeyman-B), buried cable placement, crew chief, and installation.

Academic Experience

University of Missouri-Columbia,

Department of Geography, Stewart Hall, Columbia, MO 65211 USA
September, 1977 - August, 1985: Assistant Professor [On leave: 1980-81, 1984-85]
September, 1978 - August, 1980: Chairman of Department
Courses taught: Location Theory, Cartography, Quantitative Methods, Population Geography, Planning, Southeast Asia, World Regional Geography. Other duties included Faculty Council, 1982-1984 (Chair, Student Affairs Committee 1983-84); various university committees; co-sponsor, Geographic Resources Center (a remote sensing and mapping research facility)

Oxford Polytechnic

Dept. of Social Sciences, Headington, Oxford, OX1 0BP UNITED KINGDOM
September, 1980 - May, 1981: Senior Fulbright Fellow (Exchange Professor / Visiting Lecturer)
Courses Taught: Human Geography, Southeast Asia, Political Geography

Guest Lectures

Lawrence Technological University, 1992; Loughborough University of Technology, 1981; University of Oxford, 1981 (Visiting Senior Fellow); Center for International Briefing, 1980, 1981; University of Washington, 1978; Institute for Southeast Asian Studies, 1976

Education

Ph.D., 1977, University of Michigan, Ann Arbor, MI (Geography)
M.A., 1974, University of Michigan, Ann Arbor, MI (Geography)
B.A., 1972, University of Michigan, Ann Arbor, MI (Geography/Southeast Asian Studies)
Diploma, 1968, Southfield High School, Southfield, MI

International Work Experience

1996 Malaysia, Puerto Rico (consulting, project management, training)
1995 Brazil, Malaysia, Antigua (consulting, project management, lecturing and training)
1994 Russia, United Kingdom, Ukraine, Colombia, Thailand (project management, consulting, lecturing and training)
1993 Barbados, Russia (consulting, lecturing and training)
1992 Australia, Brazil, Canada, New Zealand (consulting, lecturing and training)
1991 Australia, United Kingdom, Canada, Barbados (consulting, lecturing and training)
1980-81 United Kingdom, Netherlands (college lecturing)
1975-76 United Kingdom, Singapore, Malaysia, Brunei, Thailand (Ph.D. research)

Technical Training

Enghouse Systems Geonet Training, 1995
Andrew Corporation Mid-Range Products and Network Products Training, 1994
SUN Microsystems Seminar Series, 1990
DEWS AMS/GIS Operator Training, GeoVision, 1990
Utilities Facilities Management (FRAMME-SM), Intergraph, 1987
Basic Transmission Concepts, Austin Communications Education Services, 1987
Numerical Analysis of Remote Sensing Data, Purdue University Laboratory for Applications of Remote Sensing, 1982
Short Course on Demography, National Science Foundation, 1977
Workshop in Photography, National Geographic Society, 1973
Post-graduate courses in mathematics and computer science, University of Missouri, 1977-84

Professional Associations

American Congress on Surveying and Mapping (ACA)
Association of American Geographers
Chair, Southeast Asia Division, Asian Specialty Group, 1984-86
AM/FM International
Publications Committee, 1986-87; Standards Committee, 1986-87; Conference Committee (Seminars), Conference XI, 1988; Conference Principal and Co-Chairman, Conference XIII, 1990; Committee for Asia and the Pacific, Chairman 1990-92; Annual Conference Chairman, Conference XIV, 1991; Board of Directors, 1990-91, 1993; Australasian Conference Co-Chairman, 1991; Life Cycle Seminar, AURISA 1992 (Gold Coast, Australia); various seminars
Malaysian Branch, Royal Asiatic Society (Life Member)
Institute of Electrical And Electronics Engineers (Member)

Other Professional Activities

Advisory Board, International Society of Spatial Sciences (a division of Community Systems Foundation), 1995 - present
Editorial Board, *Solstice*, 1990 - present
Editorial Board, *Equinox*, 1989 - present
Editorial Board, Institute of Mathematical Geography, 1986 - present

Awards

1992 AM/FM International Speaker Excellence Award
1992 Who's Who In Emerging Leaders in America (first inclusion)
1991 Pe. Roberto Landell de Moura Medal, CPqD Telebras, Brazil
1991 Who's Who In American Business Leaders (first inclusion)
1990 Who's Who In The Computer Industry (first inclusion)
1990 Who's Who In The South And Southwest (first inclusion)

Personal

Date of Birth: May 17, 1950
Citizenship: United States of America

Publications

"Time Telekom's Network Inventory System: AM/FM/GIS In The Big Durian " (with Chin C.M.), *AM/FM International Automated Mapping/Facilities Management Conference XX Proceedings*, 1997 (forthcoming).

"Mapping Malaysia's Telecommunications Infrastructure: GIS at TIME Telecommunications" (with Chin C.M.), *GIS Asia Pacific*, 2:3, 34-38, 1996 (June).

"China: Spring Break '96," *KL American*, 24-27,1996 (June/July).

"The Laws Of Project Management For Automated Record Systems," *Geo Info Systems Magazine*, 4:4, 1995 (April).

"'Estado Del Arte' Y Tendencias De La Tecnologia SIG A Nivel Mundial" ("State Of The Art Of GIS Technology"), *Plan De Accion Para La Implantacion De Las Tecnologias -- SIG AM/FM -- En Colombia: Diagnostico Y Recomendaciones*, CINTEL Seminario Internacional Santiago de Cali, Agosto 31 - Septiembre 1y 2 de 1994, 33-42 (digital publication), 1994.

"GIS for Fiber Loop Communications Systems: A Russian Case Study," *AM/FM International Automated Mapping/Facilities Management Conference XVII Proceedings*, 232-239, 1994; edited version published in *Intercarto Conference: GIS for Environmental Studies and Mapping Conference Proceedings* (Moscow State University), 79-83, 1994.

Practical Handbook of Digital Mapping (Specialist Associate Editor) (with S.L. Arlinghaus, Editor-in-Chief, and W.C. Arlinghaus, W.D. Drake, and J.D. Nystuen, Associate Editors), CRC Press, 1994.

"Training Doesn't Cost: It Pays," *AM/FM International Automated Mapping/Facilities Management Conference XVI Proceedings*, 399-408, 1993.

"Principles Of Ruggedization, Or Field Access: The Last Piece In The Puzzle," *AM/FM International Automated Mapping/Facilities Management Conference XV Proceedings*, 51-60, 1992.

"Digital Maps And Data Bases Constructed From Cartographic Sources Versus Mechanically Drafted Sources: A Perspective On Aesthetics Versus Accuracy," *Solstice*, II:2, 31-37, 1991 (December 21).

"AM/FM Needs Of The 1990's", *Telephony*, 220:11, 124-128, 1991 (March 18).

"GEMS In The Pines: GIS At Lufkin-Conroe Telephone Exchange," (with P. Singletary), *Geo Info Systems Magazine*, 1:2, 22-29, 1991 (February).

"AM/FM At Coastal Utilities: A Profile In Development," *Outside Plant Magazine*, 29-33, 1989 (November).

"Data Bases As The Basis For Geographical Information Systems: A Perspective," *GIS/LIS '89 Conference Proceedings*, 123-133, 1989.

"GIS/LIS In The Long Distance Telecommunications Industry," *Third International GIS/LIS Conference (GIS/LIS '88) Proceedings*, 266-272, 1988.

"Praxis as Teratism in Digital Cartography: GIS and AM/FM for the Long Distance Telecommunications Industry," *American Congress on Surveying and Mapping 1988 Fall Convention Proceedings*, 198-205, 1988.

"Some Recent Developments In AM/FM Systems For Long Distance Carriers," *AM/FM International Automated Mapping/Facilities Management Conference XI Proceedings*, 21-31, 1988.

"Outside Plant Record Management For Fiber Optic Networks: The MIRACLES AM/FM

Project At MCI," (with C.H. Sauer III), *AM/FM International Automated Mapping/Facilities Management Conference X Proceedings*, 17-27, 1987.

A Historical Gazetteer Of Southeast Asia, Monograph No. 4, Institute of Mathematical Geography Monograph Series, Ann Arbor: Michigan Document Services, Inc., 1986.

"Service Ace," [letter] *Telephony*, 210:5, 12, 1986 (February 3).

"Raster/Vector Systems In A Production Environment," *URISA and Regional Information Systems Association Conference Papers*, 4, 203-211, 1985.

"Making Maps With Databases," *Telephony*, 208:19, 34-39, 1985 (May 13).

"Raster Systems In A Production Environment," *Design Graphics World*, 9:3, 10-15, 1985.

"An 'Everyday Atlas'," *Journal of Geography*, 83:4, 173-174, 1984.

"Measuring and Comparing Two-Dimensional Shapes," in Gaile, G.L. and Willmott, C.J. (editors), *Spatial Statistics and Models*, Dordrecht: D. Reidel Publishing, 293-312, 1984.

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"Reply To Phillips," *The Professional Geographer*, 35:2, 195-196, 1983.

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"A Definition And Estimate Of Temporal Area," *The Professional Geographer*, 34:3, 297-304, 1982.

"On Contiguity, Contact Number And Compactness (Reply To Boots And Blair)," *Area*, 14:2, 127-131, 1982.

"Comment On 'Undocumented Migration From Mexico: Some Geographical Questions'," *Annals of the Association of American Geographers*, 72:4, 559-560, 1982.

"The Compactness Of Missouri's Counties," (with T. Dowell) *Transactions of the Missouri Academy of Science*, 16, 127-130, 1982.

"The Shape Of West Malaysia's Districts," *Area*, 13:2, 145-150, 1981.

"Measures Of Population Concentration," *Oxford Polytechnic Geography Discussion*

Paper No. 15, 33 pp., 1981.

"Comments On Sopher's Measure Of Disparity," *The Professional Geographer*, 32:3, 370-371, 1980.

A Directory of Missouri Data Sources (senior author and project director), Jefferson City: Missouri Office of Administration, 318 pp. (NSF ISP78-03201/NSF7901), 1979.

Revised and edited seven chapters in *Missouri Corporate Planner*, Jefferson City: State of Missouri, Division of Commerce and Industrial Development, 1979.

"Spatial Concentration And Productivity In The Brewing Industry Of Missouri," *Transactions of the Missouri Academy of Science*, 12, 137-143, 1978.

Industrial Location Study, "Automobile Factory," Missouri Division of Commerce and Industrial Development, Jefferson City, MO, 202 pp., 1978.

Seven confidential industrial location studies for the Missouri Division of Commerce and Industrial Development: Prospect No. 32 (factory), 86 pp.; Prospect No. 34 (foundry), 57 pp.; Prospect No. 35 (factory), 54 pp.; Prospect No. 38 (factory), 56 pp.; 3 additional shorter studies, 1978.

"Cohort Survival Ratios And The 1970 Age Structure Of Sarawak's Population, " *Borneo Research Bulletin*, 9:1, 16-22, 1977.

"Some Demographic Characteristics Of The Iban Population Of Brunei, Part II: 1960-1971," *Brunei Museum Journal*, 4:1, 1-6, 1977.

Iban Migration: Patterns Of Mobility And Employment In The 20th Century, Ph.D. dissertation, Department of Geography, University of Michigan, 1977. (University Microfilms: UM77-17945) [Abstracted in *Dissertation Abstracts International*, 38:3, 1654-A and *Borneo Research Bulletin*, 10:1, 49-50.]

"Recent Malaysian Government Publications Dealing With Population In Borneo," *Borneo Research Bulletin*, 8:1, 18-22, 1976.

"Some Demographic Characteristics Of The Iban Population Of Brunei, Part I: 1947-1960," *Brunei Museum Journal*, 3:5, 64-69, 1976.

"Some Notes On The Role Of The Iban In The North Borneo Police Force," *Sarawak Museum Journal*, 45, 315-316, 1976.

"A Review Article On The Iban Of Sarawak," *Southeast Asia, An International Quarterly*, 3:3, 905-917, 1974.

(book review) West Malaysia And Singapore: A Selected Bibliography, by Karl Pelzer, *Southeast Asia, An International Quarterly*, 3:2, 797-798, 1974.

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"Digital Cartography In The Telecommunications Industry: A Glossary Of Terms, Acronyms, And Abbreviations," *Baystar Service Corporation Occasional Paper*, 1988.

MCI Transmission Systems *Outside Plant Construction Policies and Procedures Manual*, 1987.

MCI Transmission Systems *Outside Plant Field Construction Handbook* (second edition), 1987.

MCI Lightwave Systems *Outside Plant Restoration Manual*, 1986.

MCI Lightwave Systems *Outside Plant Construction Handbook*, 1986.

MCI Lightwave Systems *Outside Plant Engineering Handbook*, 1986.

MCI Lightwave Systems *Outside Plant Broadgauge Unit Price Schedule*, 1986.

"Land Base Construction For Public Utilities" (with J. Pinello), *CAS Production Report No. 403*.

"Telephone Records Conversion," *CAS Production Report No. 404*, 1985.

"Raster/Vector Systems Transfer Procedures," *CAS Production Report No. 211*, 1985.

"Computer Software: An Overview," *CAS Production Report No. 108*, 1985.

"Map Design And Aesthetics," *CAS Production Report No. 109*, 1985.

"Customary Filename Extensions At CAS," *CAS Production Report No. 111*, 1984.

"Digital Cartography at CAS - A Glossary of Terms and Acronyms," *CAS Production Report No. 110*, 1984.

"Raster Systems In A Production Environment," *CAS Production Report No. 210*, 1984.

Unpublished Conference Papers

"The Convergence of Technologies and Industries," Keynote Address, 1995 Cadtel Users Conference, Phoenix, AZ, 1995.

"Supplementary Applications That Influence AM/FM/GIS Development," AM/FM International Automated Mapping/Facilities Management Conference XVI, (Seminar VII: Organizer, Moderator, and Presenter), Orlando, FL, 1993.

"Environmental Conditioning For Field Computing," GIS/LIS '92 Conference, San Jose, CA, 1993.

"GIS *For* Business And *As* A Business," Computing for the Social Sciences, Third Annual Conference, Ann Arbor, Michigan, 1992.

"Computer Mapping As A Decision Making Tool", 18th Annual International BICSI Conference, Tampa, Florida, 1990.

"Maps And Data Bases As Tools For Development: An Overview," Association of American Geographers Annual Conference, Detroit, MI, 1985.

"American Breweries In The Post Industrial Age," (with J. Koerner and D. Rhynsburger), Association of American Geographers Annual Conference, Louisville, KY, 1980.

"Iban Migration In Sarawak, East Malaysia," Association for Asian Studies Annual Conference, Los Angeles, CA, 1979.

"Estate And Smallholder Rubber Production In Thailand And Indonesia," Association of American Geographers Annual Conference, Philadelphia, PA, 1979.

"Southeast Asian Toponyms: An Introduction," West Lakes Region, Association of American Geographers Annual Conference, Mankato, MN, 1978.

"Anisometric Interaction Fields And The Gravity Model," West Lakes Region, Association of American Geographers Annual Conference, Valparaiso, IN, 1977.

"In Defense Of Shifting Cultivation," Association of American Geographers Annual Conference, Salt Lake City, UT, 1977.

"Stress And Internal Migration In Sarawak, East Malaysia: The Case Of The Iban," East Lakes Region, Association of American Geographers Annual Conference, Ann Arbor, MI, 1976.

Project Experience

[Listed in alphabetical order by client company]

CLIENT: Alltel Carolina/Alltel Southern Region (telephone operating company and service corporation)
Project Title: CAD/E
Project Focus: outside plant
Project Manager: Bobby Woodard, Alltel Carolina, PO Box 428, Matthews, NC 28106 USA
Hardware/Software: Intergraph workstations, Intergraph FRAMME
Services Provided: training
Dates of Service: 1991

CLIENT: Ameritech Services, Inc. (telephone service corporation)
Project Title: AIRS
Project Focus: outside plant
Project Manager: Timothy Andres, Ameritech Services, 1900 E Golf Rd, Schaumburg, IL 60173 USA
Hardware/Software: Intergraph workstations, Intergraph FRAMME
Services Provided: technology assessment, training
Dates Of Service: 1990

CLIENT: Andrew Corporation (telephone competitive access provider and long distance company)
Project Title: Russian JV Info Systems
Project Focus: OSP for SDH
Project Manager: Ed Beavers, Andrew Corporation, 32A Leninski Prospekt, Moscow, RUSSIA
Hardware/Software: various microcomputers, Cadtel, AutoCad, ArcCad
Services Provided: technology assessment, system design, training
Dates of Service: 1993-1994

CLIENT: Antigua Public Utilities Authority Company (public utilities and telephone company)
Project Title: N/A
Project Focus: outside plant
Project Manager: Brian G. Larkin, Antigua Telephones PO Box 416, Saint John's, ANTIGUA
Hardware/Software: microcomputers
Services Provided: consulting, training
Dates of Service: 1995

CLIENT: AT&T - EDDS (telephone service corporation)

Project Title: (prototype system)
Project Focus: outside plant
Project Manager: Erv Thompson, AT&T-EDDS, 4 Wood Hollow Rd, Parsippany, NJ 07054 USA
Hardware/Software: various processors, including VAX and Cray, Syscan (data capture and vectorization), proprietary data base manager, customized AM/FM/GIS software
Services Provided: definition of data base structures and code lists, definition of feature rules, definition of graphics specifications, prototype system design, technology assessment, training
Dates of Service: 1988-1989

CLIENT: Barbados Telephone Company (telephone operating company)
Project Title: N/A
Project Focus: outside plant
Project Manager: Edwin Layne, Barbados Telephone Company, PO Box 272, St. Michael, BARBADOS
Hardware/Software: microcomputers, DEC workstations, GeoVision software
Services Provided: consulting, system design, technology assessment, training
Dates of Service: 1991-1993

CLIENT: C3 (computer hardware manufacturer)
Project Title: Market Analysis Study - Portable Graphics Workstations
Project Focus: equipment design and marketing
Project Manager: David Shepherd, C3, Inc., 460 Herndon Parkway, Herndon, VA 22070 USA
Hardware/Software: Intel and SPARC processors ruggedized for field use
Services Provided: feasibility study, market analysis, product development, product marketing, technology assessment, training
Dates of Service: 1991-1992

CLIENT: CDI Telecommunications (telecommunications engineering services company)
Project Title: N/A
Project Focus: outside plant
Project Manager: Bradley Cranston, CDI Telecom, 311 Park Place Blvd., Clearwater, FL 34619 USA
Hardware/Software: various microcomputers, MicroStation, GTEDS IDDS
Services Provided: market analysis, technology assessment, training
Dates of Service: 1991-1992

CLIENT: CFW Telephone Company (telephone operating company)
Project Title: N/A
Project Focus: outside plant
Project Manager: Mr. Peter H. Coffey, CFW Telephone, PO Box 1527, Waynesboro, VA

22980 USA
Hardware/Software: IBM A/S 400, microcomputers
Services Provided: technology assessment, training
Dates of Service: 1990

CLIENT: Coastal Utilities, Inc. (telephone operating company)
Project Title: AM/FM system
Project Focus: outside plant
Project Manager: Michael Valentine, Coastal Utilities, PO Box 585, Hinesville, GA 31313 USA
Hardware/Software: Intergraph VAX system, Intergraph FRAMME, IBM A/S 400
Services Provided: consulting during preparation of rules base, definition of data definition language, definition of external code lists, definition of graphics specifications, preparation of conversion specifications, preparation of land base specifications, training
Dates of Service: 1989-1991

CLIENT: CSC Intelicom (computer software vendor)
Project Title: Market Opportunities
Project Focus: work force management software and outside plant data field access software
Project Manager: Peter Winder, CSC Intelicom, 6707 Democracy Blvd., Bethesda, MD 20817 USA
Hardware/Software: various workstations and microcomputers, UNIX, C, 4-GLs
Services Provided: acquisition evaluations, joint venture evaluations, marketing, consulting, technology assessment, training
Dates of Service: 1992

CLIENT: Edmonton Telephones (telephone operating company)
Project Title: several
Project Focus: outside plant
Project Manager: Claude Mollot, EdTel, 10044 108th Street, Edmonton, Alberta, T5J 3S7 CANADA
Hardware/Software: Various processors, Enghouse CableCad (T)
Services Provided: consulting, preparation of RFP, training, validation of data base structure, validation of code lists, validation of graphics specifications
Dates of Service: 1991-1992

CLIENT: Fail Engineering Company (telecommunications engineering services company, telephone operating company consortium, holding company)
Project Title: N/A
Project Focus: outside plant
Project Manager: Bobby Hinton, Fail Engineering, PO Box 925, Bay Springs, MS 39422 USA

Hardware/Software: microcomputers
Services Provided: technology assessment, training
Dates of Service: 1990

CLIENT: Generation 5 Technology (computer software vendor)
Project Title: N/A
Project Focus: outside plant
Project Manager: Mark Wilding, G5 Technology, 8670 Wolff Court, Westminster, CO 80030 USA
Hardware/Software: GeoSQL, Oracle, AutoCad
Services Provided: definition of data base structure, definition of external code lists, definition of feature rules, definition of graphics specifications, marketing, design telephone applications
Dates of Service: 1991-1992

CLIENT: GeoTechnology International (cartographic data conversion service bureau)
Project Title: several
Project Focus: outside plant
Project Manager: Charles Rolling, GeoTechnology Intl., 3637 Medina Road, Medina, OH 44256 USA
Hardware/Software: Intergraph VAX systems, Intergraph FRAMME, IBM systems and Enghouse software, Data General hardware and proprietary software
Services Provided: as-built production, edit verification, outside plant engineering, record posting and record scrub, technology assessment, work order posting
Dates of Service: 1989-1991

CLIENT: GeoVision Systems (computer software vendor)
Project Title: DEWS, VISION*
Project Focus: outside plant
Project Manager: Perry Evans, GeoVision Systems, 5251 DTC Parkway, Englewood, CO 80111 USA
Hardware/Software: various processors, DEWS, AMS/ GIS, VISION*
Services Provided: market analysis, technology assessment, training
Dates of Service: 1991-1992

CLIENT: GTE Data Services (telephone service corporation)
Project Title: IDDS
Project Focus: AM/FM system software
Project Manager: Gerald Schick, GTEDS, 12470 E Telcom Pkwy, Temple Terrace, FL 33687 USA
Hardware/Software: Intergraph VAX systems, Intergraph T-FIDS, MicroStation PC, MicroStation 32, MicroIDDS (MicroCapture, MicroCert, MicroWPG)
Services Provided: market analysis, marketing services, product evaluation, software beta

testing, technology assessment
Dates of Service: 1989-1991

CLIENT: GTE-Florida (GTE South Area) (telephone operating company)
Project Title: ICGS
Project Focus: outside plant
Project Manager: David Lane, GTE South Area, PO Box 110, Tampa, FL 33601 USA
Hardware/Software: Intergraph VAX systems, Intergraph T-FIDS (009 GTE specifications)
Services Provided: on-premise digitizing, preparation of land base specifications, record posting, work order posting
Dates of Service: 1987-1991

CLIENT: GTE-Florida (GTE South Area) (telephone operating company)
Project Title: Planning-ICGS Interface
Project Focus: network planning
Project Manager: James Englert, GTE South Area, PO Box 110, Tampa, FL 33601 USA
Hardware/Software: Intergraph VAX, Intergraph T-FIDS (009 GTE specs), MicroStation
Services Provided: definition of data definition language and code lists, definition of graphics specifications, preparation of conversion specifications, training
Dates of Service: 1989-1990

CLIENT: Lambda Tech International (technology development company)
Project Title: GPSVision
Project Focus: mobile GPS data collection
Project Manager: David Baraniak, President, W239 N1812 Rockwood, Waukesha, WI 53188 USA
Hardware/Software: N/A
Services Provided: marketing, product development
Dates of Service: 1994-1995

CLIENT: LCTX (formerly, Lufkin-Conroe Telephone Exchange) (telephone operating company)
Project Title: GEMS
Project Focus: outside plant
Project Manager: Pat Singletary, LCTX, PO Box 1568, Conroe, TX 77305 USA
Hardware/Software: IBM RT/IBM RS 6000, GeoVision DEWS (GIS and AMS), IBM A/S 400
Services Provided: definition of data base schema, code lists, graphics specifications, preparation of land base and conversion specifications, vendor and technology assessment, training
Dates of Service: 1989-1991

CLIENT: MCI Telecommunications (long distance carrier)
Project Title: MIRACLES
Project Focus: outside plant, right-of-way
Project Manager: Jim Tatum, MCI, 400 International Parkway, Richardson, Texas 75081 USA
Hardware/Software: Intergraph VAX systems, Intergraph FRAMME, various microcomputers
Services Provided: as-built production, consulting on rules base, definition of data definition language, code lists, and graphics specifications, edit verification and acceptance testing, on-premise digitizing, preparation of land base and conversion specifications, record posting and record scrub, vendor evaluations, technology assessment, training

Dates of Service: 1985-1991

CLIENT: MSE Corporation (cartographic data conversion service bureau)
Project Title: NA
Project Focus: outside plant
Project Manager: Robert Meister, MSE Corporation, 941 N Meridian St., Indianapolis, IN 46204 USA
Hardware/Software: Intergraph VAX systems, Intergraph FRAMME
Services Provided: record posting and record scrub
Dates of Service: 1989

CLIENT: New England Telephone (telephone operating company)
Project Title: Central Artery Division Project
Project Focus: outside plant
Project Manager: Robert Bentley, New England Telephone, 425 Summer St., Boston, MA 02210 USA
Hardware/Software: evaluation study
Services Provided: technology assessment, training
Dates of Service: 1990

CLIENT: Pacific Bell Telephone Company - North Coast (telephone operating company)
Project Title: MRD
Project Focus: outside plant
Project Manager: Wendy Cline, Pacific Bell, 2125 Occidental Road, Santa Rosa, CA 95401 USA
Hardware/Software: various microcomputers, Enghouse CableCad(T) software
Services Provided: consulting, preparation of land base specifications, preparation of request for quotations, training, vendor evaluations
Dates of Service: 1991-1992

CLIENT: Pacific Bell Telephone Company - Valley Central Coast (telephone operating company)

Project Title: CAFM
Project Focus: outside plant
Project Manager: Chris Downs, Pacific Bell, 217 W Acequia, FL 1, Visalia, CA 93291 USA
Hardware/Software: various microcomputers, Enghouse CableCad(T) software
Services Provided: consulting, preparation of land base specifications, preparation of request for quotations, training, vendor evaluations
Dates of Service: 1991-1992

CLIENT: Pacific Bell Telephone Company - Orange-Riverside (telephone operating company)
Project Title: NA
Project Focus: outside plant
Project Manager: Bob Barnett, Pacific Bell, 3939 E Coronado, Anaheim, CA 92807 USA
Hardware/Software: under development
Services Provided: consulting, preparation of hardware/software specifications, training, vendor evaluations
Dates of Service: 1992-1993

CLIENT: SaskTel (telephone operating company)
Project Title: STAGES
Project Focus: outside plant
Project Manager: Glen Squires, SaskTel, 2121 Saskatchewan Dr., Regina, SK, S4P 3Y2 CANADA
Hardware/Software: various processors, software selection progress
Services Provided: consulting, feasibility analysis, software evaluation, technical assessment, training
Dates of Service: 1992-1993

CLIENT: Southern Bell Telephone (telephone operating company)
Project Title: PLRMS
Project Focus: outside plant
Project Manager: Joyce Rector, Southern Bell Telephone, 675 W Peachtree St., Atlanta, GA 30375 USA
Hardware/Software: Intergraph VAX systems, Intergraph T-FIDS
Services Provided: data conversion, record posting and record scrub, technical assessment, work order posting

Dates of Service: 1984-1985

CLIENT: Southwestern Bell Telephone (telephone operating company)
Project Title: 911-EMS
Project Focus: 911-EMS

Project Manager: Bill Horne, Southwestern Bell Telephone, 2401 E Randol Mill, Arlington, TX 76011 USA
Hardware/Software: N/A
Services Provided: technology assessment, training
Dates of Service: 1988-1989

CLIENT: Southwestern Bell Telephone (telephone operating company)
Project Title: DEWS/MPLR
Project Focus: outside plant
Project Manager: Antonio Gaber, Southwestern Bell Telephone, 308 S Akard, Dallas, TX 75202 USA
Hardware/Software: MPLR (Data General and proprietary), GeoVision DEWS (GIS and AMS)
Services Provided: work order posting (sub-contract)
Dates of Service: 1990

CLIENT: TELEBRAS CPqD (Brazilian national telephone company holding corporation)
Project Title: SAGRE
Project Focus: outside plant
Project Manager: Dr. Geovane Magalhaes, TELEBRAS CPqD, Caixa Postal 1579, Campinas 13085 SP, BRAZIL
Hardware/Software: various processors, GeoVision DEWS and VISION*, custom OSP software
Services Provided: consulting, technology assessment, training
Dates of Service: 1991-1992

CLIENT: TIME Quantum Technology/TIME Telekom (information systems division of telecommunications services company)
Project Title: Network Inventory System (NIS)
Project Focus: GIS for SDH
Project Manager: Chin Choon Moy, TQT, Floor 6, Menara Maxisegar, Jalan Pandan Indah 4/2, 55100 Pandan Indah, Kuala Lumpur, MALAYSIA
Hardware/Software: SUN workstations, Enghouse Geonet software, Oracle DBMS
Services Provided: consulting, system design, technology assessment, training
Dates of Service: 1995-1996